



# Bacteria TMDL for Lick Creek

First Public Meeting  
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Dante, VA  
November 28, 2006

# Overview of presentation

- ◆ Overview of TMDL Development
- ◆ Basis for Impairment
- ◆ Impairment Sources
- ◆ Introduction to Modeling
- ◆ Next Steps

# TMDL Development

- ◆ **Watershed and Source Characterization** – estimate bacteria loads in the watershed through GIS calculations, personal contacts, and professional opinions,
- ◆ **Modeling** – determine the contribution of each load to the stream
- ◆ **Allocation** – determine how much bacteria from various sources can enter the stream without causing water quality violations

# How can you help?

- ◆ The slides to follow describe the sources of bacteria in the Lick Creek watershed
- ◆ Your input on all the populations presented will help us improve our watershed model

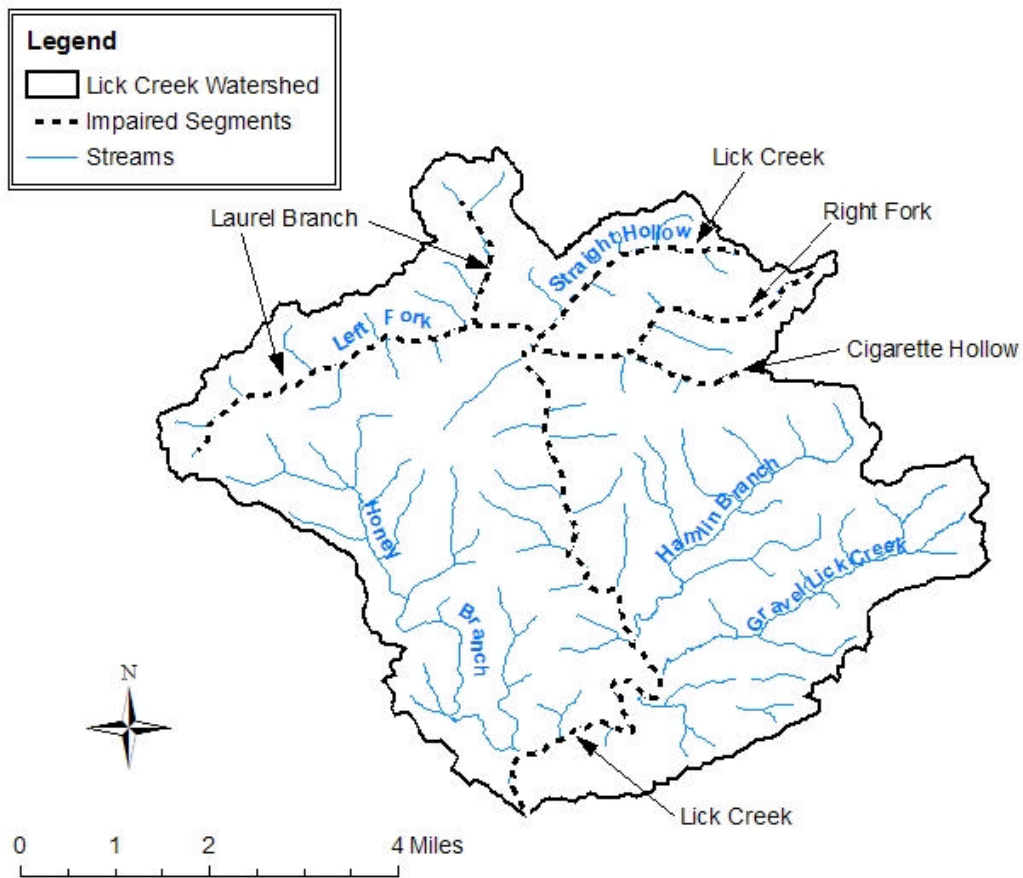


# Quick Watershed Overview

- ◆ Impaired Segments
- ◆ Location
- ◆ Land use



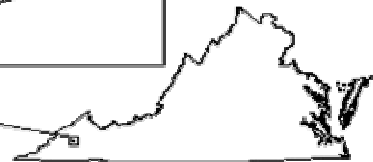
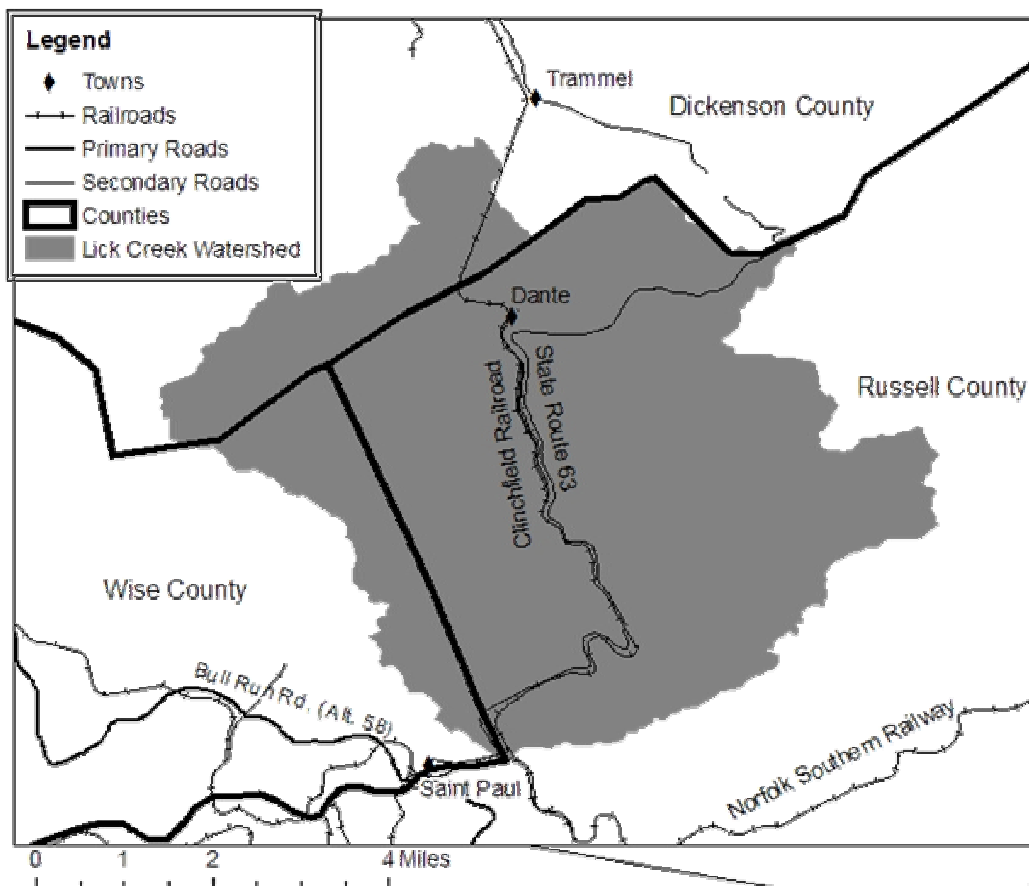
# Lick Creek Impaired Streams



## Some Basic Information

- ◆ Lick Creek is located primarily in Russell County, but extends a little into Wise and Dickenson Counties
- ◆ Lick Creek contains the towns of Dante, Sun, Gravel Lick, Hamlin, West Dante, and part of Morefield and is roughly centered on State Route 63
- ◆ Lick Creek discharges to the Clinch River at St. Paul

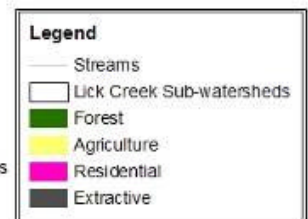
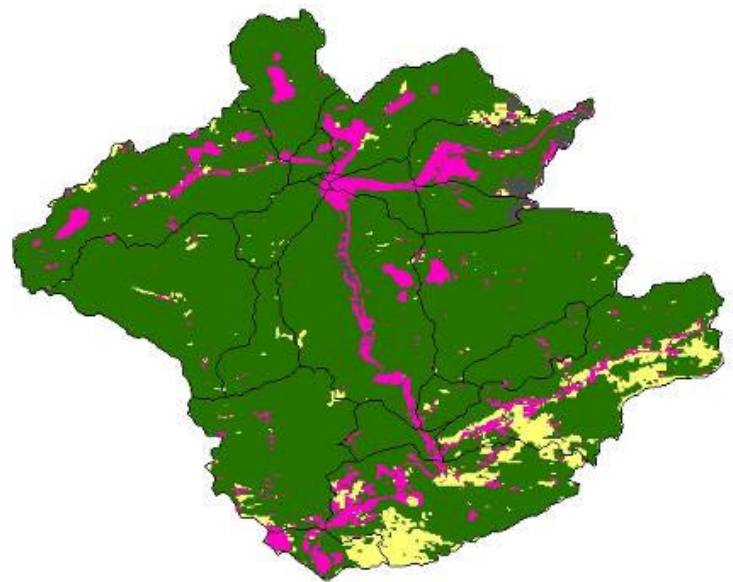
# Some more basic information





# And yet more basic information

- ◆ Watershed area:  
approx. 17,500  
acres
- ◆ Land use  
breakdown:
  - ◆ 85% forest
  - ◆ 6% agriculture
  - ◆ 8% residential/  
industrial
  - ◆ 1% extractive

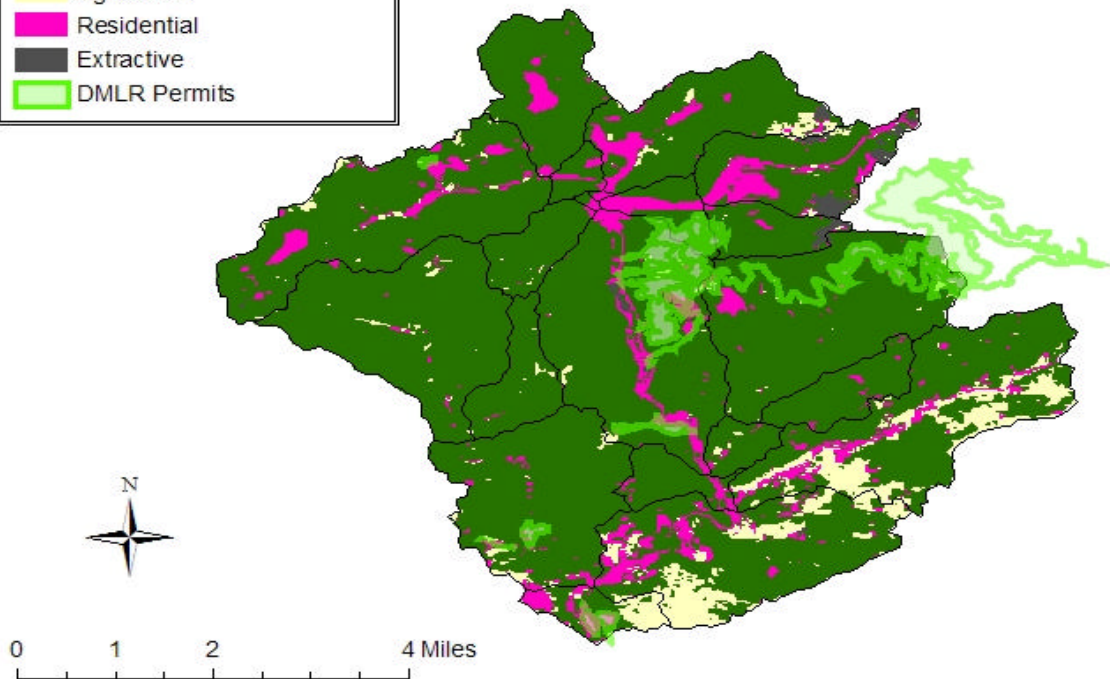
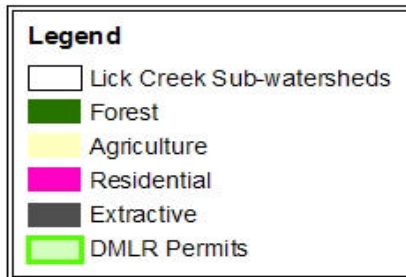




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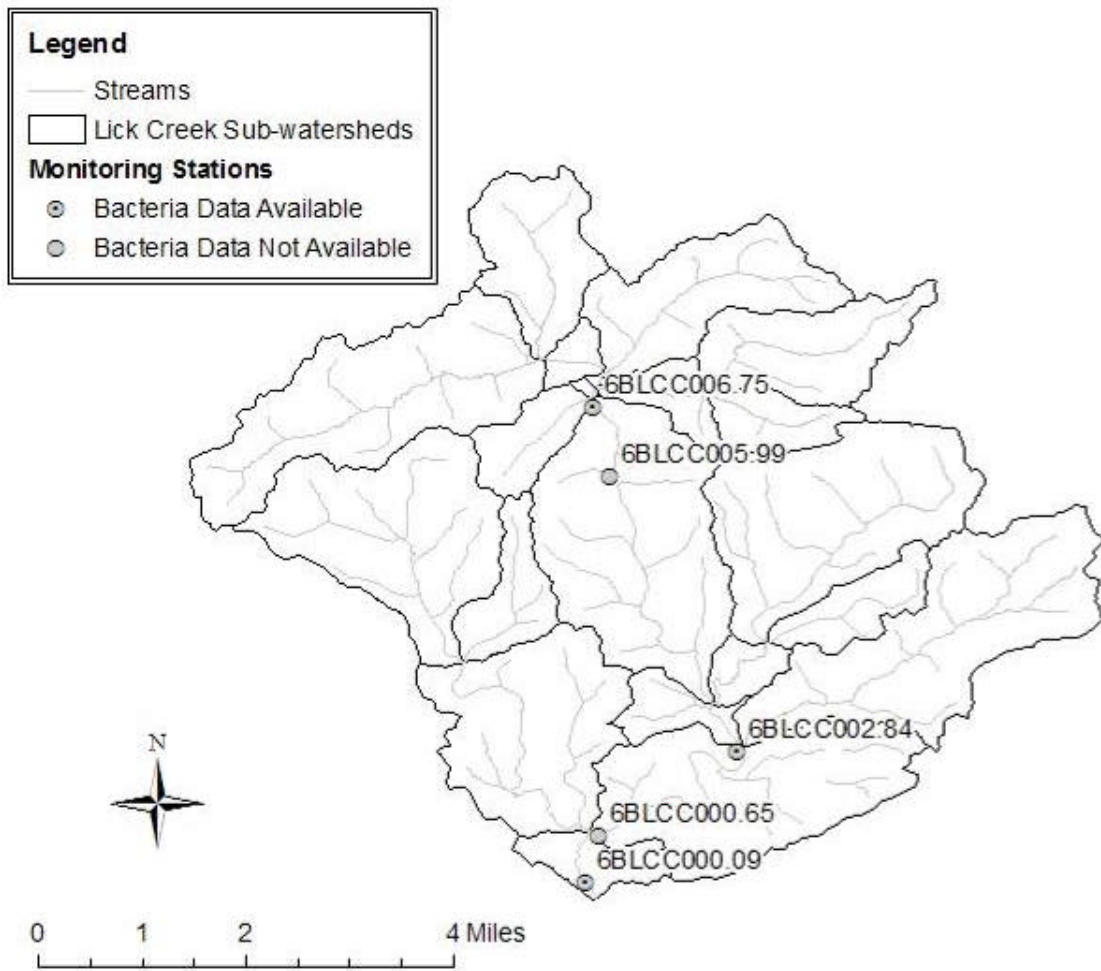
# DMLR Permits



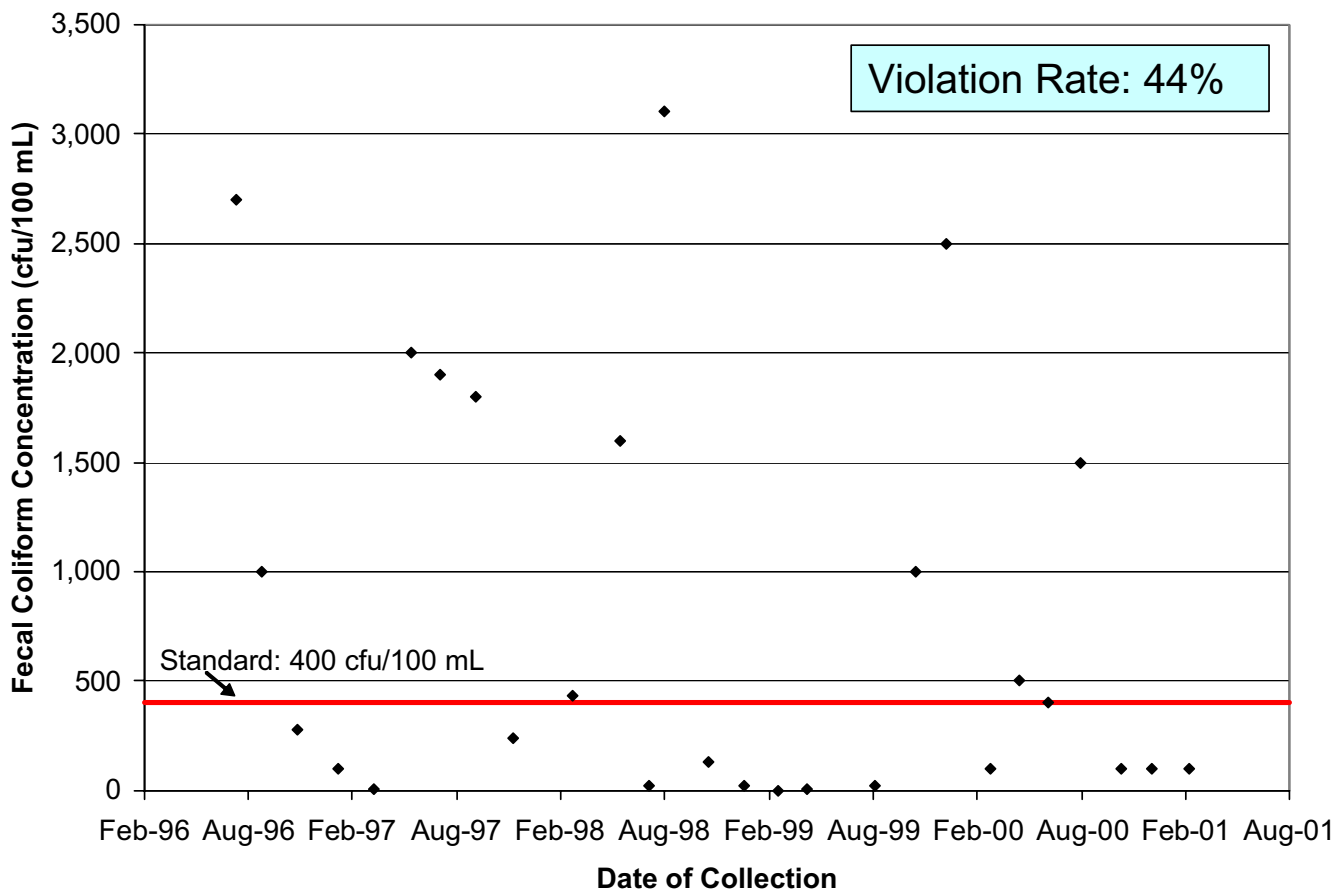
# Basis for Impairment

- ◆ Any station that exceeds the following concentrations in more than 10% of its samples is in violation of bacteria water quality standards:
  - ◆ Fecal Coliform: 400 cfu/100 mL
  - ◆ *E. coli*: 235 cfu/100 mL
  - ◆ (cfu = colony forming units)

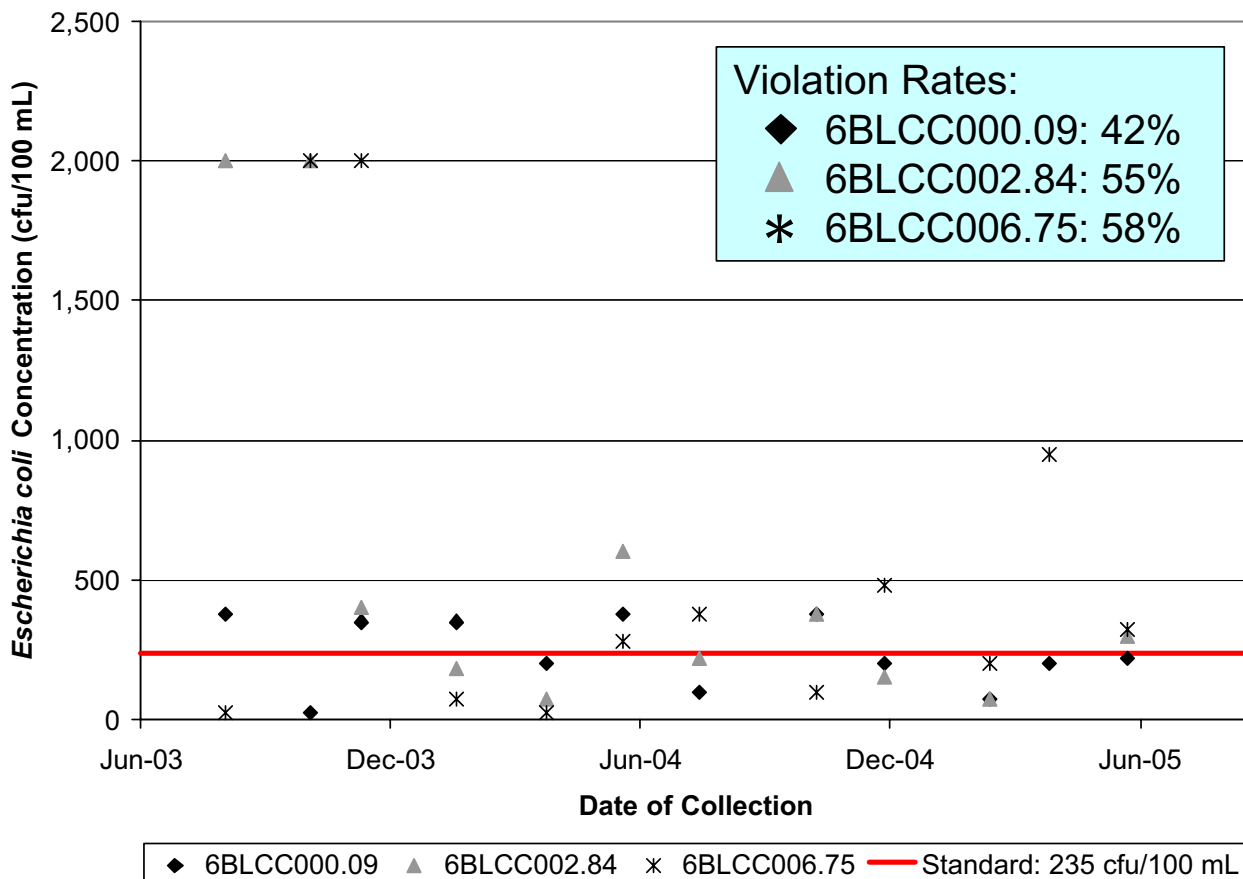
# Basis for Impairment



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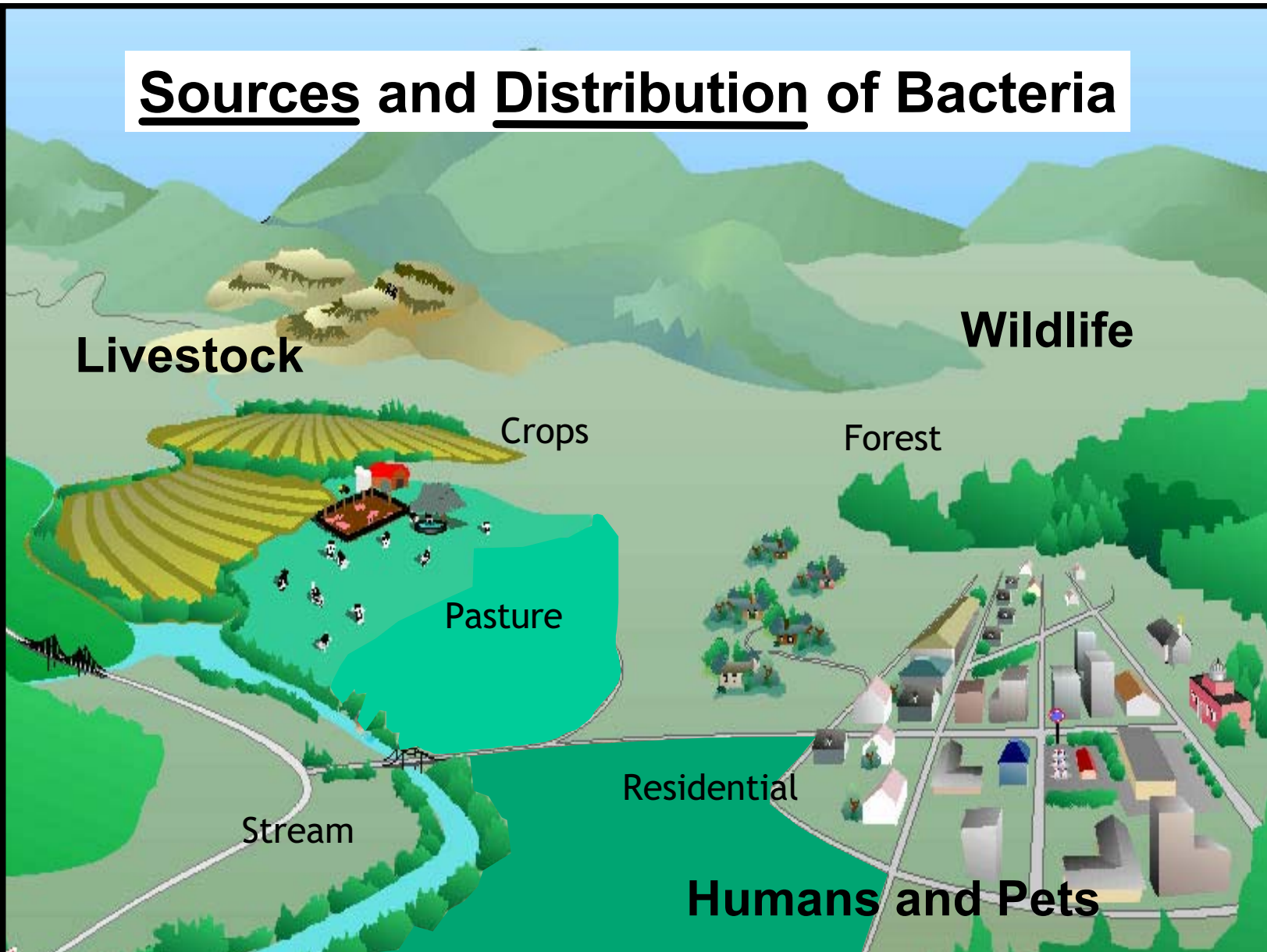
# Causes of Impairment

- ◆ Any source of bacteria to the stream

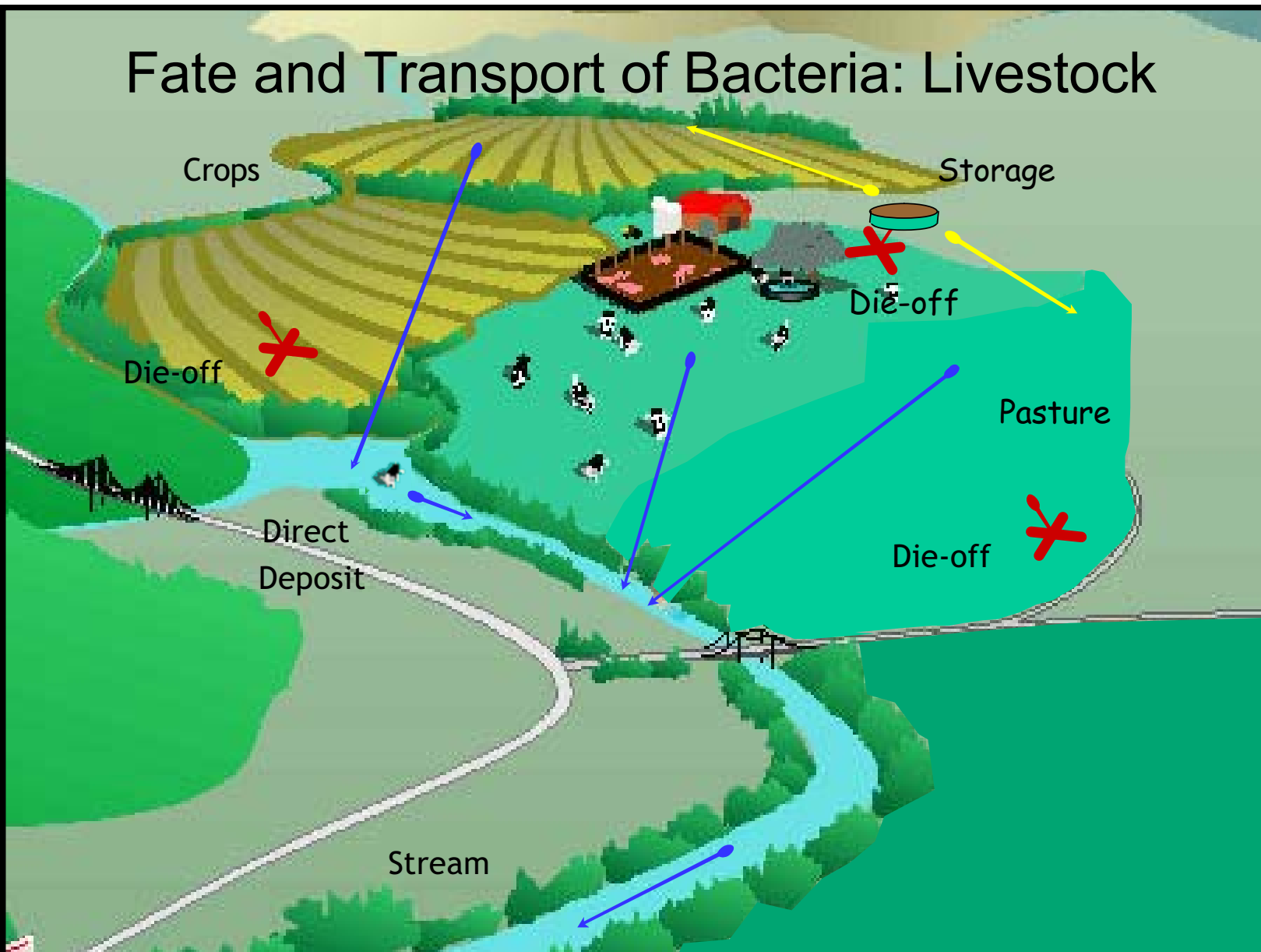


Kyle Hall, 2006

# Sources and Distribution of Bacteria



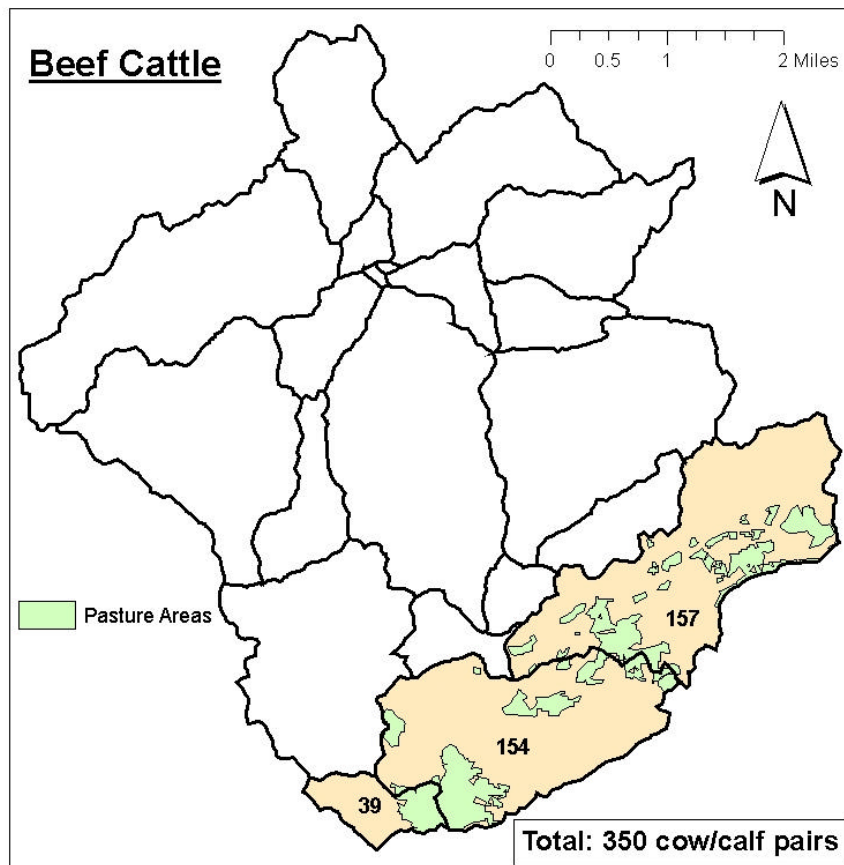
# Fate and Transport of Bacteria: Livestock



# Estimating Livestock Sources

- ◆ Beef: personnel from Virginia Cooperative Extension and the Natural Resources Conservation Service contacted local producers to obtain stocking densities
- ◆ Other livestock (pigs, horses, goats...): windshield survey and information from the technical advisory committee meeting

# Initial Estimates of Livestock Population



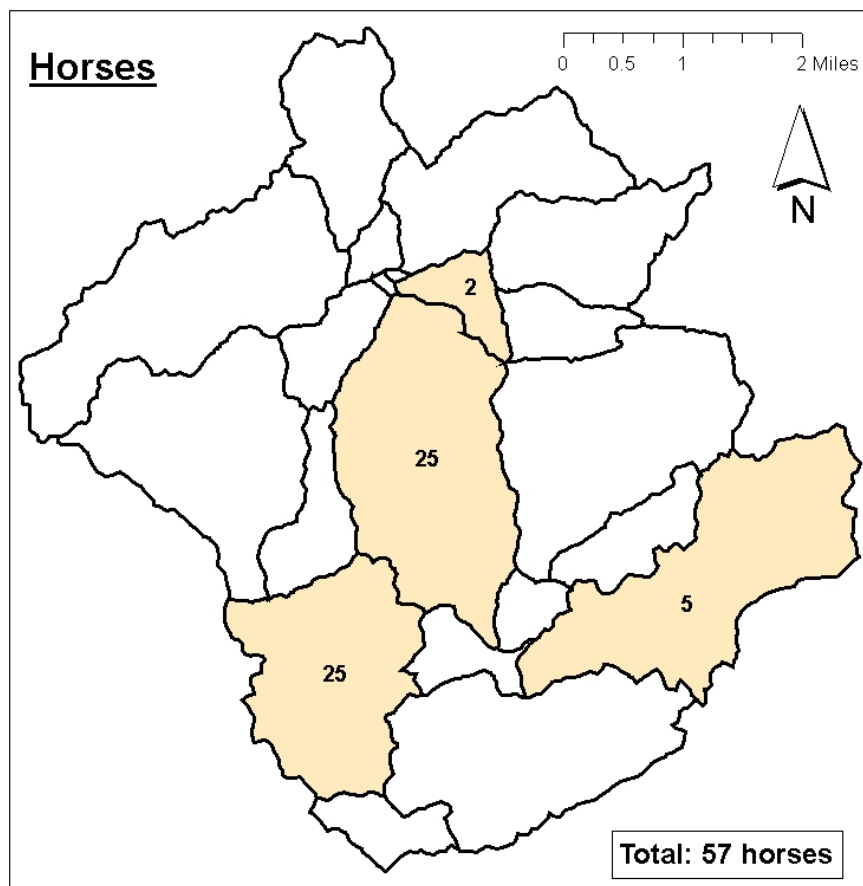


# Initial Estimates of Livestock Population

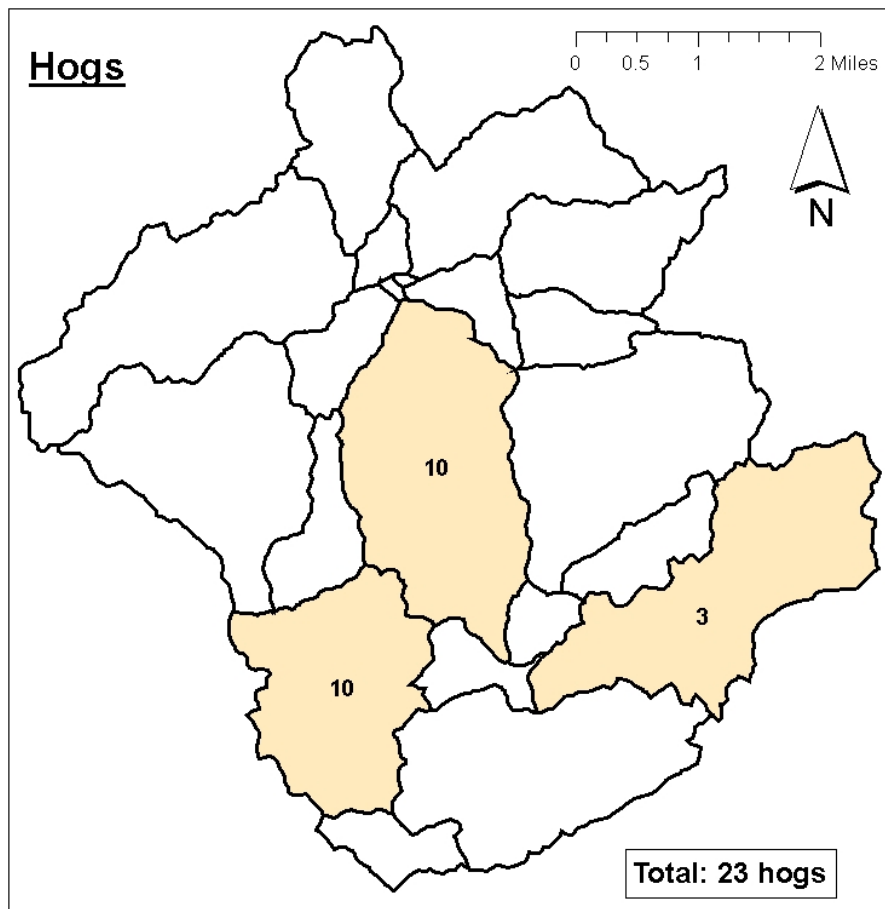




# Initial Estimates of Livestock Population



# Initial Estimates of Livestock Population



# Fate and Transport of Bacteria: Wildlife

The diagram illustrates the fate and transport of bacteria in a landscape. Key features and processes shown include:

- Die-off:** Indicated by red 'X' marks in the pasture, near the stream, and in the residential area.
- Direct Deposit:** A cow is shown defecating into the stream, representing a direct source of bacteria.
- Transport:** Blue arrows show the movement of bacteria from the pasture and residential area into the stream.
- Environments:** The landscape includes a stream, a pasture with cows, a residential area with houses, and a forest.

# Fate and Transport of Bacteria: Wildlife

The diagram illustrates the fate and transport of bacteria in a landscape. Key features and processes shown include:

- Transport Pathways:** Blue arrows indicate the movement of bacteria from the **Pasture** and **Residential** areas into the **Stream**.
- Die-off:** Red 'X' marks indicate locations where bacteria die off, occurring in the **Pasture**, near the **Stream**, and in the **Residential** area.
- Direct Deposit:** A blue arrow points to a **Direct Deposit** of bacteria into the **Stream** from a house in the **Residential** area.
- Environment:** The landscape includes **Crops**, **Pasture** (with cows), **Residential** (with houses), **Forest**, and a **Stream** flowing through the area.

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# Fate and Transport of Bacteria: Wildlife

The diagram illustrates the fate and transport of bacteria in a landscape. The landscape includes mountains, a stream, a pasture with cows, a residential area with houses, and a forest. Blue arrows show the movement of bacteria from the pasture and stream towards the residential area. Red 'X' marks indicate 'Die-off' points. A 'Direct Deposit' is shown near the stream. The diagram is labeled with 'Crops', 'Pasture', 'Stream', 'Residential', 'Forest', and 'Die-off'.

# Fate and Transport of Bacteria: Wildlife

The diagram illustrates the fate and transport of bacteria in a landscape. Key features include:

- Crops:** A yellow field with a red 'X' mark, indicating a source of bacterial input.
- Pasture:** A green field with a red 'X' mark, indicating a source of bacterial input.
- Forest:** A green area with a red 'X' mark, indicating a source of bacterial input.
- Residential:** A cluster of houses with a red 'X' mark, indicating a source of bacterial input.
- Stream:** A blue water body with arrows indicating the flow of bacteria into it.
- Die-off:** A red 'X' mark in the stream, indicating the death of bacteria.
- Direct Deposit:** A red 'X' mark in the stream, indicating the direct deposition of bacteria.

# Fate and Transport of Bacteria: Wildlife

The diagram illustrates the fate and transport of bacteria in a landscape. The landscape includes mountains, a stream, a pasture with cows, a residential area with houses, and a forest. Blue arrows show the movement of bacteria from the pasture and residential area into the stream. Red 'X' marks indicate areas of die-off or direct deposit. Labels include 'Crops', 'Pasture', 'Stream', 'Residential', 'Forest', 'Die-off', and 'Direct Deposit'.

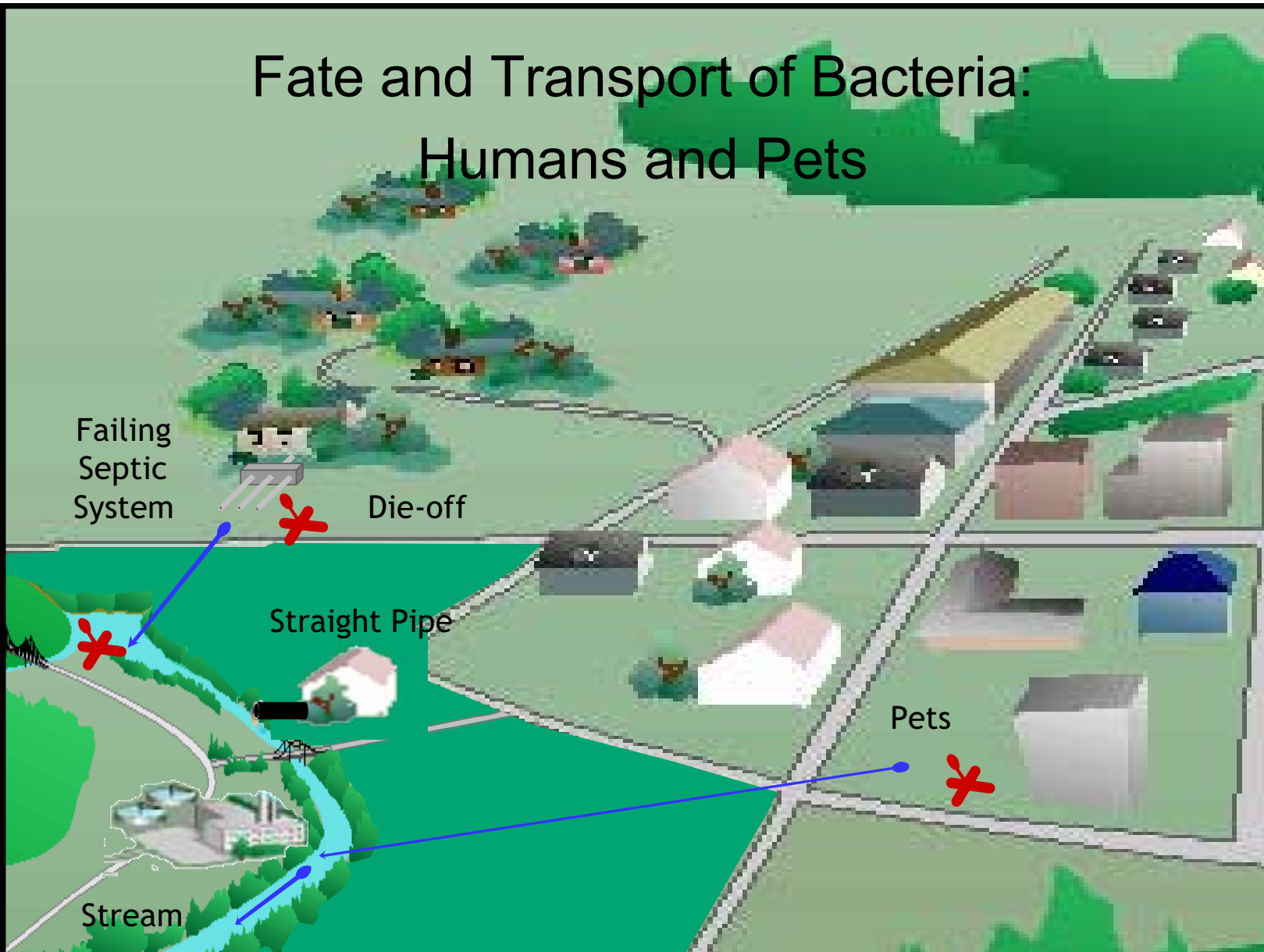
# Estimating Wildlife Sources

- ◆ Land use
- ◆ Recommendations from VDGIF, scientific literature, and previous TMDLs regarding wildlife habitat and population densities
- ◆ Wildlife habitats and population densities have been examined by local VDGIF personnel

# Initial Estimates of Wildlife Population

Deer	412
Raccoon	748
Muskrat	23
Beaver	103
Waterfowl	0
Wild Turkey	119

# Fate and Transport of Bacteria: Humans and Pets





# Estimating Residential Sources

- ◆ Humans: house locations from USGS 7.5-minute quadrangles and population densities from the 2000 Census
- ◆ Failing septic systems, direct discharges, and sewer connections estimated from local expertise
- ◆ Pets: one pet per household
- ◆ Sewer Overflows

# Initial Estimates of Human and Pet Populations

Houses	On sewer line	326
	With properly functioning septic system	447
	With failing septic system	188
	With straight pipe discharge	102
Humans		2,593
Pets		1,063

# Representing changes over time

- ◆ Sewage treatment plant was installed in 1997; prior to that time, almost all houses discharged sewage via a straight pipe directly to the stream
- ◆ Since 1997, houses have gradually been added to the sewer system, with a total of 78% of houses now connected to the sewer system
- ◆ The Health Department has also been upgrading septic systems and fixing straight pipes over the years

# Introduction to Modeling



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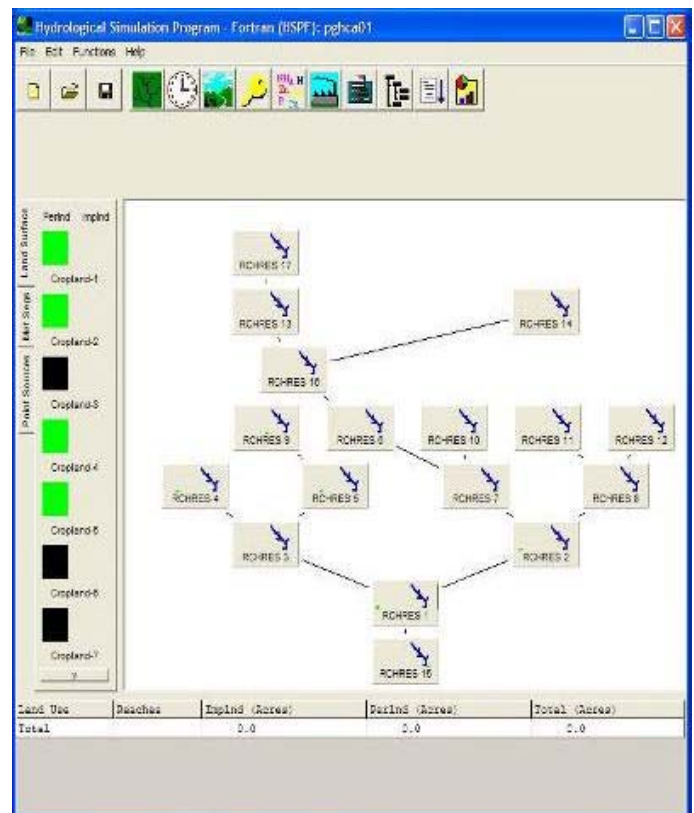
# What is a watershed simulation model?

- ◆ It is NOT:
  - ◆ A fashion model
  - ◆ A physical, constructed model
  - ◆ A statistical model

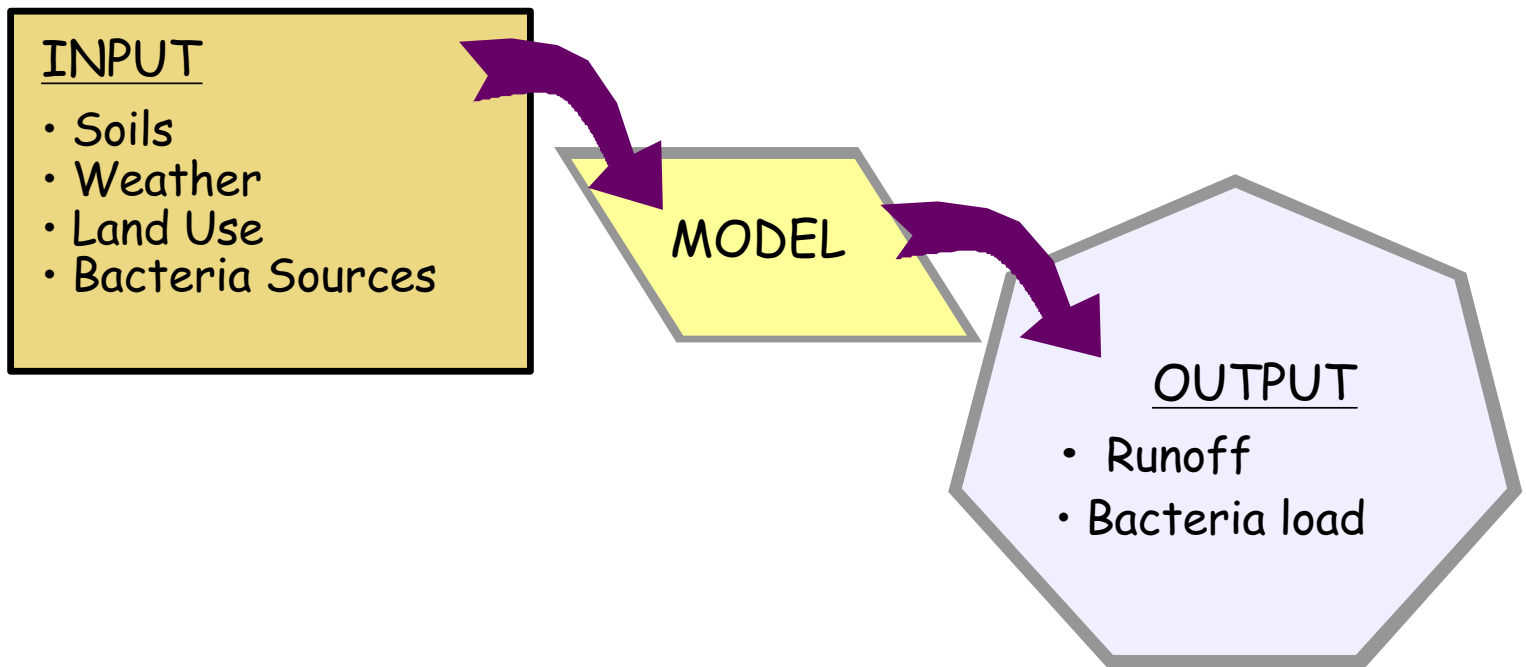


# What is a watershed simulation model?

- ◆ It is:
  - ◆ A computer program
  - ◆ A series of equations designed to represent physical processes in a watershed



# Model Process





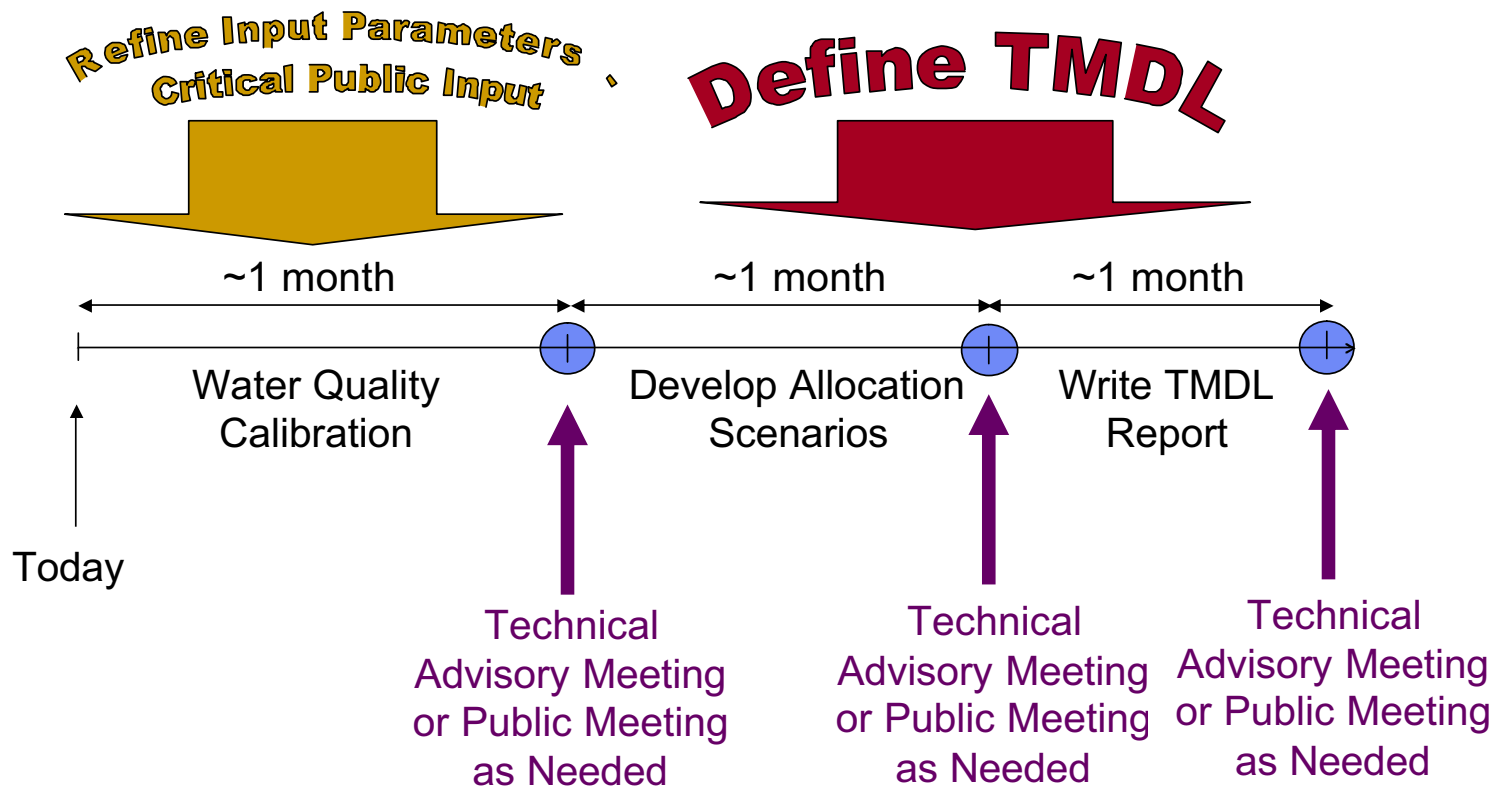
# TMDL Calculation

- ◆  $TMDL = WLA + LA + MOS$
- ◆ WLA = waste load allocation = permitted point sources
- ◆ LA = load allocation = nonpoint sources, determined through modeling
- ◆ MOS = margin of safety, implicit for bacteria TMDLs

## But Allocation is more...

- ◆ Multiple scenarios to meet the water quality standards
- ◆ Breakdown of different source contributions to the stream
- ◆ Estimate of reductions required from implementation of BMPs
- ◆ All calculated using the watershed model

# Next Steps





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